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Interactions between business conditions, economic growth and crude oil prices

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ABSTRACT

This study aims to research the empirical relationship between business conditions (BCs) and crude oil prices by employing a time series analysis for a panel of regions. BCs have been proxied by real income and real industrial production (IND) as advised in the relevant literature. Results suggest that economic activity and industrial value added are in a long-term relationship with oil price movements in the selected countries and regions. Gross domestic product (GDP) and IND are significantly affected by oil prices worldwide. Real income converges to long-term paths significantly, but at low levels through the channel of oil price movements. Oil price has a negative impact on business activities in some countries while it has a positive impact in others. Therefore, the sign of coefficient of oil prices on business conditions has found significant in this research study.

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1. Introduction

The oil industry is one of the world's largest and most capital-intensive industries. It is one of the main sources of energy and the forecast of future energy price is important in the economic analysis of design and retrofit projects as part of the operating costs (Gori, 2013). However, oil prices are highly cyclical which affects all the economic aggregates simultaneously. Therefore, changes in oil prices are very critical for the other industries. Thus, oil price swings may affect business conditions (BCs) and economic sectors in the countries (Charles & Darné, 2009).

BCs can be presented by some factors such as country politics, economics and regulations. BCs also have an important role for the economy since both small and large firms are affected by these conditions. Since both small and large firms are affected by these conditions, changes in financial performance provide expansion or contraction in the economy. Therefore, when gross domestic product (GDP) increases in the country, economic welfare and BCs in the country improve as well (Bodie, Kane, & Maecus, 2008). Effective business relations can have a positive impact on economic growth by increasing both the rate of

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investment and the productivity of investment (Dixit & Pyndick, 1994; Pyndick, 1991). Thomas (2002) and Veracierto (2002) find that in general equilibrium models, the impact of non-convex investment costs on the business cycle may be small.

Arouri (2011) mentions that oil price changes effect macroeconomic events, investment costs, firms' production structures and unemployment, consumption situation, monetary policies interest rates and inflation. Álvarez, Hurtado, Sánchez, and Thomas (2011) confirm that an increase in oil prices has more effect on certain aspects of the economy, such as finance and banking in importing countries, rather than exporting countries. These effects can be direct or indirect. Changes in oil prices have a direct effect on oil production; for example, fuels or heating oil that are common in the households' consumption. An indirect effect is through changes in industry and cost generated for goods and services, which petroleum outputs use those as inputs.

Lehwald (2012) used the Bayesian dynamic factor model for anticipating business cycles in Europe and found that macroeconomic variables were key factors in improving BCs during the 1991–1998 period. In addition, because of the debt crises in Europe after 2002 and its impacts on the economy and politics, business activities have dropped by more than 5%. Guillen, Issler, and MelloFransco-Neto (2013) found that the welfare cost of economic-growth variation is relatively large and the welfare cost of business cycles is much smaller than previously thought. This means that the representative consumer actually pays to be indifferent between actual consumption and cycle-free consumption. Boschi and Girardi (2011) suggest that economic conditions have a positive relationship with BCs. However, they forecast which oil price has negative effects on economic performance. Increases in oil prices are expected to have negative influences on the economy since it increases the costs of production.

Cali and Sen (2011) found that effective state–business relations (SBRs) can have influences on economic growth in an environment with weaker state capacity. In addition, in spite of strong economic growth in several African and Asian countries in recent years, the persistence in the size of the informal sector along with large differences in productivity and earnings between the informal and formal sectors has remained a matter of policy concern.

This study investigates interactions among BCs, economic growth and crude oil prices in the five selected regions: the Euro Area, European Union countries (who are not using EURO), Latin America and the Caribbean, South Asia and sub-Saharan Africa. These regions contain both oil-importing and oil-exporting countries, about which this research will make comparisons. Studying the relationship between BCs and oil prices is important for several reasons: Firstly, oil as an important input and raw-material in the world has great impacts on the costs of production. Changes in oil price cause an asymmetric change between sensitive sectors of each country. Secondly, industry is a major source of revenue for countries like France and Germany; therefore, changes in oil price may have lower or indirect effects for those countries so they are less dependent on fluctuations of oil price. Finally, according to portfolio management and sectors sensitive to oil price swings, some regions can have still lower dependency to oil. To the best of our knowledge, this study will be the first of its kind to investigate interaction between oil prices and BCs using a time series analysis.

The article is organised as follows: Data and methodology are introduced in section 2; section 3 presents empirical results and discussions based on our main findings. Major conclusions and policy implications are provided in section 4.

2. Data and methodology

2.1. Data

The objective of this article is to investigate long-run relationship among GDP, industrial production (IND) and oil prices in the five selected regions which were stated in the previous section. We use data from World Bank for years 1973 to 2010. Oil prices for each region have been computed by oil prices in Dubai dollars by consumer price index (CPI) of each region in dollars:

$$\text{Oil Price}_t = \text{Dubai oil price}_t / \text{CPI}_t \tag{1}$$

2.2. Theoretical setting

IND is used as a proxy for BCs in parallel to the literature studies (Chen & Czerwinski, 2000). A starting point of this study is that oil prices and BCs might be determinants of real income. Therefore, the following functional relationship can be investigated:

$$\text{GDP}_t = \text{f}\left(\text{OIL}_{t,}\text{IND}_t\right) \tag{2}$$

According to equation (2), real GDP is a function of crude oil price (OIL) and IND. It is inferred that there might be a long-term effect on crude oil prices and industrial value added on real income. Equation (2) needs to be estimated in double-log function in order to capture growth effects (Katircioglu, 2010):

$$\ln GDP_t = \beta_0 + \beta_1 \ln OIL_t + \beta_2 \ln IND_t + \varepsilon_t \tag{3}$$

Where ln GDP stands for the natural logarithm of real GDP at period t; ln OIL stands for the natural logarithm of crude oil price; lnIND stands for the natural logarithm of IND and ε stands for the error term of long-term growth model. In equation (3), the sign of coefficients for lnOIL and lnIND is positive. According to the speed of isotropy, lnGDP can be fined by expressing error correction equation; because of that lnGDP for long-term equilibrium value might not be correct by the portion of regressors:

$$\begin{aligned}\Delta \ln GDP_t = \beta_0 + \sum_{i=1}^{t} \beta_1 \Delta \ln GDP_{t-j} + \sum_{i=0}^{t} \beta_2 \Delta \ln OIL_{t-j} \\ + \sum_{i=0}^{t} \beta_3 \Delta \ln IND_{t-j} + \beta_4 \varepsilon_{t-1} + u_t\end{aligned} \tag{4}$$

where Δ denotes changes in lnGDP, lnOIL and lnIND, t is maximum number of lags, and $\varepsilon_{t\text{-}1}$ stands for the error correction term (ECT). The sign of the coefficient of ECT is expected to be negative and it shows the speed of adjustment to GDP towards its long-term path (Katircioglu, 2010).

2.3. Empirical methodology

Initially we apply a standard unit root test for determining integration level of our series, which is Phillips-Perron (PP) approach. These tests are based on the null hypothesis of a unit root. Because of the fact that PP tests do not consider breaks in the series, we carry out the Zivot-Andrews (ZA) test checking unit roots with one break, additionally and for comparison purposes. The null hypothesis of ZA test is the same with PP tests.

Then we apply the bounds tests through the Autoregressive Distributed Lag (ARDL) approach that has been proposed by Pesaran, Shin, and Smith (2001) to determine a long-run relationship among variables. The proposed tests are based on the F-statistics computed from the ARDL models. Two sets of critical values are provided, which are for lower bounds and for upper bounds. Additionally, F-tests are carried out in three different scenarios as suggested by Pesaran et al. (2001): F_{III}, F_{IV} and F_V. If computed F-value does not fall above upper bounds, then the null hypothesis of no level relationship cannot be rejected. If it falls within lower and upper limits, the test is inconclusive; and If F-value falls beyond the upper limit then the null hypothesis of no level relationship is rejected and its alternative of a level relationship is accepted (Pesaran et al., 2001), The ARDL structure for estimating long-term relationships includes the following error correction model (ECM):

$$\begin{aligned}\Delta \ln GDP_t &= a_0 + \sum_{i=1}^{t} b_i \Delta \ln GDP_{t-i} + \sum_{i=0}^{t} c_i \Delta \ln OIL_{t-i} + \sum_{i=0}^{t} d_i \Delta \ln IND_{t-i} \\ &+ \sigma_1 \ln GDP_{t-1} + \sigma_2 \ln OIL_{t-1} + \sigma_3 \ln IND_{t-1} + \varepsilon_{1t}\end{aligned} \tag{5}$$

According to equation (5), Δ is the difference operator, lnGDP is the natural logarithm of dependent variable, GDP, lnOIL and lnIND are the natural logarithms of independent variables of crude oil price and IND respectively, t is maximum number of lags and ε_{1t} stands for the error term of the model. The F-test will be utilised to seek for a long-run association between GDP and its possible determinants in equation (5). While lnGDP is dependent variable, the null hypothesis of no level relationship is $H_0{:}\sigma_1 = \sigma_2 = \sigma_3 = 0$ and the alternative hypothesis of a level relationship is $H_1{:}\sigma_1 \neq \sigma_2 \neq \sigma_3 \neq 0$. We employed three scenarios of III, IV and V in F-tests in parallel to the work of Pesaran et al. (2001) as mentioned earlier. Some time series data may show short-run dynamics, while they converge to the similar case of equilibrium in their long-run position. Because of this reason, this study goes to the next step that sets up an ECM. After confirming long-run relationship, long-run and short-run, coefficients together with corrections term need to be estimated (Gujarati, 2004). There is an advantage of using bounds test over the other tests, such as Johansen methodology, that it allows regressors to be of mixed order of integration at maximum of one.

The ECM, which utilises the ARDL procedure, will be estimated through equation (4), once long-term relationship is obtained in equation (5).

3. Empirical results and discussion

We investigate the existence of a long-term equilibrium relationship between GDP and its regressors (oil prices and IND) in the selected five regions for the years from 1973 to 2010. We begin our analysis by carrying out unit root tests for testing integration level of variables. Then, we test for long-run relationships among the series as proposed in equation (2). Finally, we perform the conditional ECMs to estimate the ECT, long-term and short-term coefficients.

3.1. Unit root tests

Table 1 gives the PP unit-root test results for series under consideration. In the case of Euro Area and European Union, GDP and oil variables are non-stationary at levels but become stationary at first differences, whereas IND is stationary at its level as confirmed by the PP tests. Therefore, GDP and oil are said to be integrated of order one, I(1), whereas IND is said to be integrated of order zero, I(0). In the case of Latin America and the Caribbean, South Asia and sub-Saharan Africa, real GDP, OIL and IND variables are non-stationary at their levels but become stationary at their first differences. Therefore, GDP, OIL and IND are said to be integrated of order one, I(1) for these three regions.

Unit-root tests have provided mixed results for the variables of this study. Therefore, the ZA test will be employed additionally in order to confirm the stationary nature of variables, which allows one break in the series.

Table 2 gives the ZA unit-root test results for variables under consideration. In the case of Euro Area and European Union, real GDP and IND variables are non-stationary at their levels but stationary at their first differences, whereas the oil variable is stationary at its level. Therefore, GDP and IND are said to be integrated of order one, I(1), whereas oil is said to be integrated of order zero, I(0). It is seen that results from the ZA tests are the same with the results of Augmented Dickey-Fuller (ADF) and PP tests in the case of Euro Area and European Union. In the case of Latin America and the Caribbean, real GDP and OIL variables are non-stationary at their levels but become stationary at first difference, whereas

Table 1. PP (1988) Unit Root Test.

	With Constant	And time trend	With constant,	But no time trend
Variables	Level	First difference	Level	First difference
Euro Area				
Ln GDP	-1.3027[2]	-5.0151[5]*	-1.8286[4]	-4.8309[4]*
Ln IND	-2.5630[3]	-5.5881[5]*	-1.1276[4]	-5.6489[5]*
Ln Oil	**-2.4258**[2]	-7.7698[0]*	**-2.4143**[3]	-7.8637[1]*
European Union				
Ln GDP	-1.9922[2]	-4.5994[5]*	-1.1315[3]	-4.5882[4]*
Ln IND	-2.7135[3]	-5.5630[6]*	-0.9048[5]	-5.6413[6]*
Ln Oil	-2.3677[3]	-7.8682[1]*	-2.3158[3]	-7.8698[2]*
Latin America and the Caribbean				
Ln GDP	-2,4462[1]	-4.2817[4]*	-0.4945[0]	-4.4178[4]*
Ln IND	-2.6025[1]	-4.3972[5]*	-0.5028[2]	-4.5304[5]*
Ln Oil	-1.4055[3]	-7.2066[3]*	-0.9314[3]	-7.0490[3]*
South Asia				
Ln GDP	-0.7610[0]	-7.4202[3]*	4.3221[4]	-6.0670[3]*
Ln IND	-1.2491[3]	-4.6542[7]*	2.9882[7]	**-4.4428**[3]*
Ln Oil	-2.5609[3]	**-7.3399**[2]*	-1.5526[3]	-7.4751[2]*
Sub-Saharan Africa				
Ln GDP	0.2357[2]	-4.7079[2]*	1.9939[2]	-3.7462[2]*
Ln IND	-0.7290[3]	-3.8096[1]**	1.1794[2]	-3.5459[0]**
Ln Oil	-2.1698[3]	-7.3184[2]*	-1.1923[2]	-7.3456[2]*

Note: This table reports the results of the Pillps-Perron (PP) tests applied to time series data. The test is based on the null hypothesis of a unit root. All of the series are at their natural logarithms. GDP represents real gross domestic product; IND represents industrial productions; oil represents oil prices. When using PP test, numbers in brackets represent Newey-West Bandwith (as determined by Bartlett-Kernel). PP test unit root test where performed from the most general to the least specific model by eliminating trend and intercept across the models.
Source: Authors' own calculations.
*, ** and *** denote rejection of the null hypothesis at the 1%, 5% and 10% levels respectively. The bold values '-2.42' and '-2.41' are not statistically significant, while the bold values '-4.44' and'-7.33' are statistically significant at the 1% level. Test for unit roots have been carried out in E-VIEWS 6.0.

Table 2. Zivot and Andrews Test.

Variables	Ln Oil	Ln GDP	Ln IND
Euro Area			
Model A	-4.615[0]	-3.637[2]	-3.769[1]
Model B	-5.417[0]	-4.090[2]	-3.281[0]
Model C	-5.246[0]	-3.947[2]	-3.952[0]
European Union			
Model A	-4.684[0]	-3.542[1]	-4.107[1]
Model B	-5.210[0]	-3.656[1]	-3.394[0]
Model C	-4.993[0]	-4.218[3]	-4.022[0]
Latin America and the Caribbean			
Model A	-3.696[0]	-2.161[0]	-5.058[4]
Model B	-4.691[0]	-3.902[2]	-4.709[2]
Model C	-4.539[0]	-2.703[0]	-4.929[4]
South Asia			
Model A	-4.640[0]	-2.775[0]	-3.521[0]
Model B	-4.896[0]	-3.400[0]	-4.083[1]
Model C	-4.633[0]	-3.353[0]	-4.147[1]
Sub-Saharan Africa			
Model A	-4.971[0]	-2.335[2]	-2.579[1]
Model B	-4.679[0]	-5.102[2]	-3.036[1]
Model C	-4.314[0]	-4.970[2]	-4.132[0]

Note: This test includes three models, those are: model A, model B and model C and critical values at 1%, 5% and 10% significance levels are -4.24, -4.80 and -5.34 respectively for model A, and -4.93, -4.42 and -4.11 respectively for model B and, -5.57, -5.08 and -4.82 respectively for model C. It is quoted to remind that the all and alternative hypothesis of ZA tests are the same with those in ADF and PP tests.
Source: Authors' own calculations.

IND variable is stationary at its level. Therefore, GDP and OIL are said to be integrated of order one, I(1), whereas IND is said to be integrated of order zero, I(0). This finding for IND variable is different from what was provided by the PP tests. In the case of South Asia, real GDP and IND variables are non-stationary at their levels but become stationary at their first differences, whereas OIL variable is stationary at its level.

The variables, GDP and IND are said to be integrated of order one, I(1), whereas OIL is said to be integrated of order zero, I(0), which is again a different conclusion compared to the PP tests. In the case of sub-Saharan Africa, finally, variable is non-stationary at its level but become stationary at first difference, whereas GDP and oil variables are stationary at their levels. Therefore, IND is said to be integrated of order one, I(1), whereas GDP and OIL are said to be integrated of order zero, I(0), which is again different conclusion compared to the PP tests.

3.2 Bounds tests and conditional ECMs

It is clear that unit root tests provided mixed results leading to conclusion that regressors in equation (3) are of mixed order of integration. It is highly important to note that dependent variable in equation (2) for all the regions have been found to be integrated of order one, I(1), based on the results of PP and ZA tests. Therefore, it is now possible that bounds tests can be now initiated in order to investigate the long-run equilibrium relationship between GDP and its regressors in equation (3). The critical values for F-tests using small samples are presented in Table 3, which are gathered from Narayan (2005). Table 4 gives the results of the bounds tests for level relationship between GDP and its regressors as modelled in equation (3). Bounds tests have been carried out in three different model options, as

Table 3. Critical Values for the ARDL Modelling Approach.

K=2	0.10		0.05		0.01	
	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
F_{IV}	3.66	4.37	4.36	5.13	5.98	6.97
F_{V}	4.47	5.42	5.38	6.43	7.52	8.80
F_{III}	3.37	4.37	4.13	5.26	5.89	7.33

Note: K is the number of regressors for the dependent variable in ARDL models, F_{IV} represents the F-statistic of the model with unrestricted intercept and restricted trend, F_{V} represents the F-statistic of the model with unrestricted intercept and trend, and F_{III} represents the F statistic of the model with unrestricted intercept and no trend. Source: Narayan (2005) for F-statistics.
Source: Authors' own calculations.

Table 4. Bounds Tests for Level Relationships.

	With Deterministic Trends			Without Deterministic Trend	
Variables	F_{IV}	F_{V}		F_{III}	Conclusion
Euro Area					
F (lnGDP / lnOIL, lnIND)					H_0
$p=3^*$	9.851c	8.652c	$p=1^*$	9.764c	
4	1.842a	1.601a	2	3.936b	Rejected
5	1.773a	1.784a	3	3.265a	
6	1.345a	1.533a	4	0.987a	
European Union					
F (lnGDP / lnOIL, lnIND)					H_0
$p=3^*$	7.000c	6.432c	$p=1^*$	8.191c	
4	2.421a	2.036a	2	2.185a	Rejected
5	5.023b	5.141b	3	2.632a	
6	2.237a	2.684a	4	1.824a	
Latin America & Carribean					
F (lnGDP / lnOIL, lnIND)					H_0
$p=1^*$	5.951c	7.765c	$p=1^*$	5.432c	Rejected
2	2.702a	3.581a	2	1.604a	
3	3.274a	4.362a	3	3.865a	
4	1.411a	1.563a	4	1.044a	
South Asia					
F (lnGDP / lnOIL, lnIND)					H_0
$p=3^*$	4.251b	4.784b	$p=3^*$	5.222c	Rejected
4	2.074a	2.743a	4	2.087a	
5	1.471a	1.931a	5	2.074a	
6	2.853a	3.658a	6	4.173a	
Sub-Sharan Africa					
F (lnGDP / lnOIL, lnIND)					H_0
$p=2^*$	4.533c	2.969a	$p=2^*$	3.455b	Rejected
3	2.067a	1.544a	3	2.293a	
4	2.584a	0.846a	4	2.951a	
5	9.429c	5.932c	5	7.710c	

Note: Schwartz Criteria (SC) was used to select the number of lags required in the co-integration test. p shows lag levels and.
Source: Authors' own calculations.
*denotes optimum lag selection in each model as suggested by SC. F_{IV} represents the F statistic of the model with unrestricted intercept and restricted trend, F_{V} represents the F statistic of the model with unrestricted intercept and trend, and F_{III} represents the F statistic of the model with unrestricted intercept and no trend. t_V and t_{III} are the t ratios for testing $\sigma_1 = 0$ in equations (15) through (20) with and without deterministic linear trend.; [a]İndicates that the statistic lies below the lower bound. [b]That it falls within the lower and upper bounds. [c]That it lies above the upper bound.

mentioned previously, and which are with restricted deterministic trends (F_{IV}), with unrestricted deterministic trends (F_{V}) and without deterministic trends (F_{III}). Intercepts in these scenarios are all unrestricted (Pesaran et al., 2001).

The results in Table 4 suggest that the application of the bounds F-test using the ARDL modelling approach suggest level relationships in the model. Because of the null hypotheses

Table 5. Level coefficients in the long-run growth models through the ARDL approach.

	Dependent Variable		Regressors	
	lnGDP	lnOIL	lnIND	Intercept
Euro Area	-	-0.024*	0.702*	9.563
European Union	-	-0.018**	0.283	21.326*
Latin America and the Caribbean	-	0.011*	0.838*	5.402
South Asia	-	0.011	0.936*	3.098*
Sub-Saharan Africa	-	0.100*	-0.127	28.429

Notes: Numbers in brackets are prob. values of t statistics in each model.
Source: Authors' own calculations.
*, ** and *** denote the statistical significance at the 1%, 5%, and 10% levels respectively.

Table 6a. Conditional error correction models through the ARDL approach.

Panel (a). Euro Area				Panel (b). European Union			
Dependent Variable: GDP (5, 1, 3)[a]				Dependent Variable: GDP (5, 5, 2)[a]			
Regressor	Coefficient	Standard Error	T-Test	Regressor	Coefficient	Standard Error	T-Test
$\hat{u}_{t-1}$	-0.2545	0.0554	-4.5911	$\hat{u}_{t-1}$	-0.2491	0.0630	-3.9504
$\Delta lnGDP_{t-1}$	0.2047	0.1539	1.3299	$\Delta lnGDP_{t-1}$	-0.0845	0.1680	-0.5028
$\Delta lnGDP_{t-2}$	0.2782	0.1484	1.8747	$\Delta lnGDP_{t-2}$	0.1328	0.0426	3.1131
$\Delta lnGDP_{t-3}$	-0.0454	0.0346	-1,3111	$\Delta lnGDP_{t-3}$	0.0888	0.0467	1.8995
$\Delta lnGDP_{t-4}$	-0.1168	0.0366	-3.1908	$\Delta lnGDP_{t-4}$	-0.0977	0.0343	-2.8436
$\Delta lnOIL$	-0.0037	0.0017	-2.1852	$\Delta lnOIL$	-0.0024	0.0015	-1.6444
$\Delta lnIND$	0.4582	0.0147	31.0414	$\Delta lnOIL_{t-1}$	0.0038	0.0020	1.9218
$\Delta lnIND_{t-1}$	-0.0718	0.0736	-0.9753	$\Delta lnOIL_{t-2}$	0.0030	0.0020	1.5292
$\Delta lnIND_{t-2}$	-0.1585	0.0785	-2.0190	$\Delta lnOIL_{t-3}$	0.0057	0.0018	3.1556
Intercept	0.0027	0.0020	1.3399	$\Delta lnOIL_{t-4}$	0.0038	0.0013	2.8560
				$\Delta lnIND$	0.4984	0.0171	29.0232
				$\Delta lnIND_{t-1}$	0.1663	0.0909	1.8298
				Intercept	0.0044	0.0030	1.4373
Adj. R^2= 0.9866, S.E. of Regr. = 0.0021, AIC = -9.1610, SBC = -8.7076, F-stat. = 189.5564, F-prob. = 0.000, D-W stat. = 2.2312				Adj. R^2= 0.9900, S.E. of Regr. = 0.0020, AIC = -9,3041, SBC = -8.7146, F-stat. = 165,4214, F-prob. = 0.000, D-W stat. = 2.3838			

[a]Denotes p lag structures in the model.
Source: Authors' own calculations.

Table 6b. Conditional error correction models through the ARDL approach (continued).

Panel (c). Latin America and the Caribbean				Panel (d). South Asia			
Dependent Variable: GDP (2, 2, 4)[a]				Dependent Variable: GDP (3, 1, 1)[a]			
Regressor	Coefficient	Standard Error	T-Test	Regressor	Coefficient	Standard Error	T-Test
$\hat{u}_{t-1}$	-0.4828	0.1116	-4.3238	$\hat{u}_{t-1}$	-0.3906	0.0796	-4.9026
$\Delta lnGDP_{t-1}$	0.4807	0.1397	3.4410	$\Delta lnGDP_{t-1}$	-0.2477	0.0860	-2.8812
$\Delta lnOIL$	-0.0028	0.0033	-0.8400	$\Delta lnGDP_{t-2}$	-0.0663	0.0905	-0.7322
$\Delta lnOIL_{t-1}$	-0.0080	0.0035	-2.2462	$\Delta lnOIL$	-0.0058	0.0064	-0.9103
$\Delta lnIND$	0.07336	0.0337	21.7400	$\Delta lnIND$	0.7754	0.0767	10.1020
$\Delta lnIND_{t-1}$	-0.3356	0.1035	-3.2422	Intercept	-0.0004	0.0076	-0.0537
$\Delta lnIND_{t-2}$	-0.0905	0.0381	-2.3725				
$\Delta lnIND_{t-3}$	0.0526	0.0396	1.3291				
Intercept	0.0044	0.0026	1.6682				
Adj. R^2= 0.9622, S.E. of Regr. = 0.0053 AIC = -7.4096, SBC = -7.0056, F-stat. = 79.7544, F-prob. = 0.000, D-W stat. = 1.9183				Adj. R^2= 0.8323, S.E. of Regr. = 0.0099, AIC = -6.2262, SBC = -5.9595, F-stat. = 28.7978, F-prob. = 0.000, D-W stat. = 2.0233			

[a]Denotes p lag structures in the model.
Source: Authors' own calculations.

Table 6c. Conditional error correction models through the ARDL approach (continued).

Panel (e). Sub-Saharan Africa			
Dependent Variable: GDP (8, 5, 7)[a]			
Regressor	Coefficient	Standard Error	T-Test
$\hat{u}_{t-1}$	-0.3725	0.0588	-6.3285
$\Delta lnGDP_{t-1}$	-0.0837	0.1592	-0.5260
$\Delta lnGDP_{t-2}$	-0.5767	0.1258	4.5838
$\Delta lnGDP_{t-3}$	-0.2204	0.1755	-1.2554
$\Delta lnGDP_{t-4}$	-0.0781	0.1041	-0.7504
$\Delta lnGDP_{t-5}$	0.6736	0.1144	5.8844
$\Delta lnGDP_{t-6}$	0.5278	0.1026	5.1420
$\Delta lnGDP_{t-7}$	0.0599	0.0898	-0.6676
$\Delta lnOIL$	0.0019	0.0042	0.4719
$\Delta lnOIL_{t-1}$	-0.0011	0.0039	-0.2861
$\Delta lnOIL_{t-2}$	-0.0101	0.0052	-1.9543
$\Delta lnOIL_{t-3}$	-0.0074	0.0060	-1.2425
$\Delta lnOIL_{t-4}$	0.0129	0.0055	2.3492
$\Delta lnIND$	0.5981	0.0408	14.6446
$\Delta lnIND_{t-1}$	0.0197	0.0813	0.2426
$\Delta lnIND_{t-2}$	-0.1163	0.0552	-2.1042
$\Delta lnIND_{t-3}$	-0.0070	0.0579	-0.1217
$\Delta lnIND_{t-4}$	-0.1153	0.0523	-2.2026
$\Delta lnIND_{t-5}$	-0.3547	0.0648	-5.4679
$\Delta lnIND_{t-6}$	-0.3612	0.0835	-4.3232
Intercept	7.7123	0.0062	1.2307
Adj. R^2= 0.9924, S.E. of Regr. = 0.0030,			
AIC = -8.5343, SBC = -7.5534,			
F-stat. = 59.4348, F-prob. = 0.000,			
D-W stat. = 2.3575			

[a]Denotes p lag structures in the model.
Source: Authors' own calculations.

of H_0:$\sigma_1 = \sigma_2 = \sigma_3 = 0$ in, equation (5) can be rejected according to the bounds F-tests' results. In the case of all regions, real GDP as a dependent variable is in a long-run relationship with oil prices and industrial value added. Therefore, conditional ECMs can now be estimated to capture short-term coefficients and ECTs for each region, which is conditional upon imposing the ECT. However, prior to estimating ECMs, long-run coefficients will be estimated through the ARDL mechanism.

The results of level coefficients in the long-term periods are provided in Table 5. In the Euro Area, we see that long-term coefficient of oil price is -0.024 as expected and for industry is 0.702 again as expected which both are statistically significant at the 0.01 level. In the case of European Union, similar results have been obtained; however, the coefficient of lnIND is not significant. In contrast to Euro area and European Union, different results have been obtained in the case of Latin America and the Caribbean, South Asia, and sub-Saharan Africa. This is to say, in the cases of Latin America and the Caribbean, South Asia, and sub-Saharan Africa, the coefficient of oil prices is positive but not significant in the case of South Asia. Furthermore, the coefficient of lnIND in the case of sub-Saharan Africa is negative but not significant.

Finally, in the next step, estimations of ECMs and ECTs are provided through Table 6a and Table 6c. It is clearly seen that ECTs in all of the regions are negative and statistically significant, but all of them are less than 50%; which this finding raises a reality that there are important determinants that make GDP react to its long-term equilibrium path other than oil prices and industrial value added. For example, in the case of Euro Area, the ECT is -0.2545 (β = -0.2545, $p < 0.01$) denoting that GDP in the Euro Area reacts to its long-term equilibrium path by 25.45% speed of adjustment every year through the channels of oil prices and industrial activity. This case is similar in the other regions as can be seen in Tables 6a, 6b, and 6c. The highest ECT has been obtained in Latin America and the Caribbean.

When the short-term coefficients are evaluated in Tables 6a through 6c, it is seen that mixed signs of coefficients have been obtained, which can be explained by the regional economic realities. But, generally, the sign of short-term coefficients for the level of oil prices (without lags) are negative as expected. And finally, diagnostic test results provided in Tables 6a through 6c show that results are robust and do not contain any autocorrelation.

4. Conclusion and policy implications

This article has empirically investigated the effects of oil prices on BCS in the Euro Area, European Union, Latin America and the Caribbean, South Asia, and sub-Saharan Africa. BCs have been proxied by real GDP and industrial value added as relevant to the previous literature. Results of the present study reveal that a long-run equilibrium relationship exists between real GDP, oil prices, and industrial value added in all of the regions. Results show that oil prices generally exert negative long-run effects on real income while industry exerts positive effects as expected. Results of ECMs reveal that real income converges towards its long-term equilibrium path at low levels but significantly through the channels of oil markets and industrial activity. All of these results revealed similar findings with only a few exceptions. The short-term effects of oil prices on real income revealed similar patterns like long-term effects.

This study has shown that oil prices exert negative effects on BCs. Some important policy implications are available for policymakers in this respect. As a result of rapid technological progress and developments, investments on renewable energies and alternative energy systems. Therefore, switching towards these new energy systems should be a major priority of countries in order to reduce or minimise negative effects of oil markets on the economies. Further research areas are available within this topic to investigate the effects of oil markets on BCs in the case of major oil producers and importers for comparison purposes.

Disclosure statement

No potential conflict of interest was reported by the authors.

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